

Description

[CHIP STRUCTURE]

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the priority benefit of Taiwan application serial no. 92119227, filed July 15, 2003.

BACKGROUND OF INVENTION

[0002] Field of Invention

[0003] The present invention relates to a chip structure. More particularly, the present invention relates to an improved passivation structure for protecting an opening.

[0004] Description of Related Art

[0005] In the semiconductor fabrication, the production of integrated circuit (IC) is basically divided into three stages: wafer fabrication, IC fabrication, and IC package. Wherein, a die is accomplished after the steps of wafer fabrication, circuit design, circuit fabrication, and wafer cutting. For each accomplished die, cutting from the wafer, after the bonding pads of the die are electrically coupled to exter-

nal signal lines, the die is packaged. The purpose of packaging the die is to prevent the humidity, thermal energy, and noise from affecting on the die. Also and, the package also provides a way for allowing the die to be electrically coupled to the external circuit, such as the printed circuit board or other packaging substrate. As a result, packaging process on the IC is accomplished.

[0006] Referring to FIG. 1, it is a top view, schematically illustrating a conventional structure of opening in a passivation layer. Each chip (or die) 100 cutting from the wafer has multiple bonding pads 110. The bonding pads 110 are arranged on the active surface 102 of the chip 100, so as to serve as a connection terminal of the chip 100 to the external signal. In addition, in order to prevent the outmost circuit pattern of the chip 100 from being damaged due to contamination and mechanical effect, the active surface 102 of the chip 100 is formed with a passivation layer 104. This passivation layer 104 is formed by, for example, depositing an organic protection material or an inorganic protection material, for covering the active surface 102 of the chip 100. Also and, the passivation layer 104 covers over a portion of surface of the bonding pad 110 and the surface of the transmission line 114. The other portion of

the top surface 112 of the bonding pad 112, which portion is not covered by the passivation layer 114, has an opening being formed, so as to serve as a connection via used by the subsequent fabrication processes of forming bump or bonding.

[0007] It should be noted that the opening 106 formed in the conventional passivation layer 104 usually is a circular opening. However, when the operation speed of the chip 100 increases, it is often that a large amount of current flows to the opening 106 above the bonding pad 110 via the transmission line 114, and is gathered at the profile surface 108 of the circular opening near to the transmission line 114. This causes that the current density at the profile surface 108 is larger than the current density at other peripheral surface, and further causes the phenomenon of current overcrowding. Even more severe, for the under bump metallurgic (UBM) layer above the bonding pad 110, the metallic atoms, under a long period of current affection, have gradually flowed away due to electromigration. It even further causes an open circuit between the bonding pad 110 and the UBM layer (not shown), and affects the lifetime of the chip 100.

SUMMARY OF INVENTION

- [0008] The invention provides a chip structure, so that the current density flowing through the opening of the passivation layer can be in better uniformity, and the phenomenon of overcrowding current can be reduced.
- [0009] For achieving the foregoing objective, a chip structure is provided in the invention. The chip has at least a bonding pad and a transmission line coupled with the bonding pad. The bonding pad and the transmission line are disposed on a surface of the chip. In addition, the passivation layer covers over a surface of the chip and the passivation layer has an opening to expose the bonding pad. The cross-sectional profile of the opening is composed of a straight line and an arc connected to the two ends of the straight line. The straight line is near to a connection terminal of the transmission line and the bonding pad.
- [0010] For achieving the foregoing objectives, the invention provides a chip structure. The chip has at least a bonding pad and a transmission line coupled with the bonding pad. The bonding pad and the transmission line are disposed on a surface of the chip. In addition, the passivation layer covers over a surface of the chip and the passivation layer has an opening to expose the bonding pad. The cross-sectional profile of the opening is composed of a curve

line and an arc connected to the two ends of the curve line. The curve line is concave to the arc and the curve line is near to the connection terminal of the transmission line and the bonding pad.

[0011] According to an embodiment of the invention, the foregoing straight line and the curve line are near to the connection terminal. When the current flows to the opening above the bonding pad through the transmission line, since the cross-sectional profile of the opening include straight line or the curve line, which are not the conventional circular opening, it can be effectively avoided that the current density are gathered at the profile surface of the conventional opening. As a result, the current is rather uniformly distributed on the straight line or the curve line. This can solve the phenomenon of the current overcrowding.

BRIEF DESCRIPTION OF DRAWINGS

[0012] The accompanying drawings are included to provide a further understanding of the invention, and are incorporated in and constitute a part of this specification. The drawings illustrate embodiments of the invention and, together with the description, serve to explain the principles of the invention.

- [0013] FIG. 1 is a top view, schematically illustrating a conventional structure of opening in a passivation layer.
- [0014] FIG. 2 is a top view, schematically illustrating a structure of opening in a passivation layer, according to an embodiment of the invention.
- [0015] FIG. 3 is a top view, schematically illustrating a structure of opening in a passivation layer, according to another embodiment of the invention.

DETAILED DESCRIPTION

- [0016] Referring to FIG. 2, it is a top view, schematically illustrating a structure of opening in a passivation layer, according to an embodiment of the invention. A chip 200 has multiple bonding pads 210, and the bonding pads 210 are, for example, arranged in a planar array on the active surface 202 of the chip 200, so as to serve as terminals for connecting to external signals. In addition, in order to prevent the outmost circuit pattern layer 216 of the chip 200 from being damaged due to the external contamination or mechanical effect, the active surface 202 of the chip 200 is formed with a passivation layer 204. This passivation layer 204 is formed by, for example, depositing an organic protection material or an inorganic protection material, for covering the active surface 202 of the chip

200. Also and, the passivation layer 204 covers a portion of the surface of the bonding pad 210 and the surface of the transmission 214. The other portion not being covered by the passivation layer 204 form an opening 206 above the surface 212 of the bonding pad 210, so as to serve as the connection via being used for the subsequent fabrication process for forming the bumps and bonding.

[0017] In the embodiment, the cross-sectional profile of the opening 206 of the passivation layer is composed of a straight line 208 and an arc 208a connecting to the two ends of the straight line 208. In this manner, a portion of the cross-sectional profile of the conventional circular opening 106 has been properly processed and the shape has been changed. In FIG. 2, for the procession on the opening 206, it can, for example, be that a filling method is used to have a straight line 208 on the cross-sectional profile of the opening 206 near to the transmission line 214. This straight line 208 is, for example, a string of the conventional circular opening 106, and is extending along a direction perpendicular to the transmission line 214 at the connection end with the bonding pad 210. Therefore, when the current flows through the transmission line 214 and toward the opening 206 above the bonding pad 210,

since the cross-sectional profile of the opening 206 near to the transmission line 214 is a straight line but not the conventional circular shape, it can be avoided that the current density over gathers on the profile surface 108 of the conventional circular opening. Instead, the current is rather evenly distributed on the straight line 208 of the opening 206. This can reduce the phenomenon of current overcrowding. In the invention, in order to not affect the area of the conventional opening 106, the length of the straight line 208 can preferably be less than or equal to the radius R of the conventional opening 106. However, under the situation without considering the opening area, the length of the straight line 208 can also be between the diameter and radius of the arc 208a. In this situation, the opening can be approaching to the half circle.

[0018] In addition to using the straight line for the opening 206, the invention alternatively proposes another embodiment of the opening structure in the passivation layer. Referring to FIG. 3, the chip 200 has multiple bonding pads 210. The top surface 212 of the bonding pad 210 without being covered by the passivation layer 204 has an opening 207 above. In this embodiment, the opening 207 in the passivation layer 204 is composed of a curving line 209

and an arc 209a connected to two ends of the curving line 209, wherein the curving line 209 can be concave into the arc 209a. The curving line 209 is at the location near to a connection terminal between the transmission line 214 and the bonding pad 210. Therefore, when the current flows to the opening 207 above the bonding pad 210 via the transmission line 214, since the side profile of the opening has a curving line 209 at the portion near to the transmission line 214 but not the conventional circular opening, it can be avoided that the current density overly gathers on the profile surface of the conventional circular opening 106. Instead, the current is rather evenly distributed on the curving line 209 of the opening 207. This can reduce the phenomenon of current overcrowding.

[0019] In the preferred condition, each point of the curving line 209 has an equal distance D to the connection terminal between the transmission line 214 and the bonding pad 210. In this manner, the current density on each point of the curving line 209 can have the effect of uniform distribution. In addition, in order not to affect the area of the opening 207, the length of the curving line 208 can preferably be less than or equal to the radius R of the arc 209a, and curvature of the curving line 209 can be less

than or equal to the curvature of the arc 209a. However, under the situation without considering the opening area, the length of the straight line 208 can also be increased, and the curvature can be larger than the curvature of the arc 209a. Thus, the shape of the opening 207 is approaching to a crescent-like shape.

[0020] According to the foregoing descriptions, the improved structure for the side profile of the opening of the passivation layer in the invention is about a circular profile, but the portion near to the transmission line is a straight line or a curving line. As a result, when the current flows through this part, the current density can be uniformly distributed along the straight line or the curving line, and whereby the phenomenon of overcrowding current can be reduced. In addition, by the improved opening structure, the possibility of open circuit between the bonding pad and the UBM layer due to electromigration is reduced, and the chip lifetime can be prolonged.

[0021] It will be apparent to those skilled in the art that various modifications and variations can be made to the structure of the present invention without departing from the scope or spirit of the invention. In view of the foregoing descriptions, it is intended that the present invention covers

modifications and variations of this invention if they fall within the scope of the following claims and their equivalents.